

ART. XI.—*Croup: its History, Nature, and Treatment.* By ALBERT NEWMAN, M. D. The Dissertation to which the Fiske Fund Prize was awarded, June, 1855.¹ (Published by request of the Rhode Island Medical Society.)

THE disease usually designated by the term *croup* is confined almost entirely to infancy and childhood, though a considerable number of cases have been recorded as occurring in adults, and presenting all the essential symptoms of the disease, including the formation of false membrane in the air-passages. By reference to the eleventh report to the Legislature of Massachusetts, relating to the registry of births, marriages, and deaths in that State, for the year ending December 31, 1852, we find that 429 deaths occurred from croup, during the year, in that State. Of these, 71 were between the ages of five and ten, and one upwards of twenty years old. The remaining 357 were under five. 243 were boys, and 178 girls.² They were scattered very regularly all over the State, 316 occurring in the nine eastern, and 113 in the five western counties. The annual average of four years, ending December 31, 1852, from the same cause, was 367. The whole number of deaths from croup, occurring in the State during eleven years and eight months, ending December 31, 1852, amounted to 3,000. According to the same report, which probably contains as reliable information upon this point as any statistics yet published, we find that of 6,914 children which died under five years of age, during the year 1852, 351, or over five per cent., died of croup.

From such statistics it appears that croup is one of the most fatal and frequent diseases of childhood. It is hardly possible to doubt that this disease has existed from the earliest ages, though confounded by the ancients with other diseases affecting the throat and air-passages.³ It was first described as a distinct disease by Dr. Blair, in 1718; yet extremely accurate and vivid descriptions of the disease are found in the writings of Hippocrates, Celsus, Galen, and their successors, though masked by the absurd pathology of their time. It was not, however, till after the publication of the essay of Dr. Home, of Edinburgh, in 1765, that it came to be recognized as a specific disease.

In 1807, the Emperor Napoleon proposed a prize for the best essay on croup, in consequence of the death of his nephew, his then contemplated successor to the throne of France. This called forth numerous productions.

¹ The Trustees of the Fiske Fund, at the annual meeting of the Rhode Island Medical Society, held at Providence, June 6, 1855, announced that they had awarded to the author of the dissertation bearing the motto "*Corn from the sheaves of Science, with stubble from mine own garner*," the premium of fifty dollars, by them offered for the best dissertation on the following subject, viz: "*Croup*."

Upon breaking the seal of the accompanying packet, they ascertained its author to be Albert Newman, M. D., of Attleborough, Massachusetts.

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² The sex of 8 was not reported.

³ See *American Journal of the Medical Sciences*, vol. iii. pp. 56-57.

Previous to this many valuable essays had appeared from our own countrymen, Drs. Rush, Bard, Chalmers, and others. In 1811, Dr. David Hosack published a valuable essay on this disease, containing substantially the pathology of the affection which has been generally adopted to the present time.¹ Dr. H. maintains the inflammatory character of the disease, and says that in eighteen years' practice he had never met with a case uncomplicated with symptoms of local inflammation.

We believe croup to be always an inflammation of the mucous membrane of the larynx, extending generally to the trachea also, and not infrequently more or less deeply into the bronchial tubes. Associated with the inflammation there is always spasm of the laryngeal muscles. Spasm of these muscles may exist independent of inflammation or of vascular irritation, constituting a distinct disease, essentially different in its nature and pathology from croup, with which it should not be confounded. It is an affection of the spinal nervous system, and is caused by irritation in some part of the system, often by dentition or disordered bowels. This affection we shall designate by the term *laryngismus*; merely saying, in explanation, that we mean thereby a spasmodic condition of the muscles of the larynx analogous to that which occurs in croup, but, unlike that, depending not upon inflammation of the mucous membrane of the larynx, but upon an irritation in some other part of the system.

Symptoms and Course.—The disease is frequently preceded for two or three days by a catarrh. The patient is affected with cough, hoarseness, sneezing, suffusion of the eyes, &c. After the continuance of the catarrh for two or three days, and often without any such precursory signs, febrile symptoms make their appearance. The patient, if old enough to describe his feelings, complains of chilliness, alternating with heat, headache, and occasionally of pain in the back and limbs. The pulse becomes frequent and hard, the skin hot, the face slightly flushed, the eyes red and watery, and the tongue white and loaded at its base. These symptoms are not infrequently so slight, especially in young children, as to escape detection altogether; and, when observed, generally precede for a few hours only the appearance of the symptoms about to be noticed. This is the *precursory stage*—the *stage of invasion* of Guersent. After the continuance of the above symptoms for a longer or shorter time, or, it may be, without any such symptoms having been observed, the fully-developed state of the disease is ushered in. In the majority of instances this occurs in the early part of the evening and during sleep. The patient starts out of sleep with a peculiar, dry, ringing cough, which it is scarcely possible to describe, but which cannot fail to be recognized after having been once heard. The cough is frequent, and immediately succeeded by a dry, hissing, sonorous inspiration. Expiration is performed quicker than natural, whilst inspiration is much prolonged. The voice is rough and hoarse. There is dyspnoea, often severe, exciting strong voluntary efforts in aid of respiration. The head is thrown back, the respiratory muscles act with great force, and the whole aspect of the patient is that of one labouring for breath. Sometimes the patient complains of pain, with a sensation of constriction, about the larynx, which is occasionally slightly swollen externally. There is scanty expectoration, often slightly tinged with blood. The fauces, if examined, will generally be found red, and sometimes covered with patches of false membrane. Sometimes, however, no abnormal appearances are to be seen. A more

¹ Am. Med. and Phil. Register, vol. ii. p. 40.

or less complete remission of these symptoms usually occurs in the morning. The pulse, however, remains frequent, the cough loses nothing of its peculiar character, and inspiration, though less laboured, still remains stridulous. The remission may continue through the day; but, if the patient falls asleep, he is apt to awake with an aggravation of all the symptoms. Occasionally there is no return of the dyspnoea, the cough and hoarseness soon subside, and health is again established. And this result sometimes occurs without treatment. Usually, however, on the return of evening, if not before, the symptoms become aggravated. The cough is more difficult, the stridor of inspiration louder, and the patient's anxiety and want of breath much increased. The voice becomes broken and occasionally quite suppressed. The imperfect aeration of the blood begins now to be manifested by slight lividity of the lips and cheeks, especially during coughing. Sometimes the cheeks are extremely pale and tumid. As the disease advances, the extremities become cool, and the pulse very frequent, feeble, and irregular. There is drowsiness and stupor, and occasionally delirium. The bowels are constipated, and the urine in small quantity and high coloured throughout the course of the disease. If the disease is not arrested either by treatment or the efforts of nature, the remissions become less and less marked, and all the urgent symptoms increased. The pulse and respiration are much increased in frequency and diminished in force. The head is constantly thrown back, and all the respiratory muscles act forcibly. Death may occur suddenly during an exacerbation of the laryngismus, or it may occur as the result of a slower suffocation, preceded by an increase of all the signs of impeded respiration before mentioned, with a cold skin, clammy sweats, a feeble, irregular, or intermittent pulse, and, finally, coma. Vomiting is usually followed by momentary relief, especially in the earlier stages of the disease. Occasionally patches, and sometimes perfect tubes, of false membrane are ejected. When this occurs, it is generally followed by temporary relief; often, however, the symptoms return with all their former violence, and death succeeds. If the patient is old enough to expectorate, the matter coughed up at first is glairy, viscid, and fibrinous, but becomes purulent as the disease proceeds. In any stage of the disease, a favourable termination is indicated by a diminution of the frequency of the pulse, the difficulty of respiration, hoarseness, and of the frequency and peculiarity of the cough.

The severity of the symptoms varies much in different cases. Sometimes they are of sufficient intensity to destroy life in a few hours; and, again, the sports of the little patient, during the day, are scarcely abridged. And between these extremes there is every degree of variation and danger. No case, however, ought for a moment to be considered free from danger. In the mildest cases, sudden and dangerous aggravations are not uncommon. If there is any increase of the frequency of the pulse and heat of the skin, with stridulous inspiration and a "croupal" cough, judicious treatment should be at once instituted, and steadily persevered with so long as they continue. Not infrequently the inflammation extends to the bronchial tubes, and the symptoms of bronchitis become superadded to those of croup. The duration of the disease varies from one or two days to as many weeks. The greatest proportion of deaths is said to occur at about the fourth day.

Varieties and Modifications.—Several writers recognize and describe two varieties of croup, viz: *catarrhal croup* and *membranous croup*. The essential difference between these two varieties is claimed to be the constant presence of false membrane in the latter, and its constant absence in the former. Guersent, Bretonneau, and Bouchut consider no cases true croup in which false

membrane is not formed.¹ We do not think that the presence of false membrane has any claim to be considered either the pathognomonic symptom of the disease, or the characteristic of a distinct variety. Nor can we see any practical benefit to be derived from such distinction; the nature and pathology of the disease being, as we shall endeavour hereafter to show, essentially the same in cases in which false membrane is formed, as in those in which it is not. It is, we believe, admitted on all sides that it is impossible to determine, in the forming stage of any case, whether it will assume the membranous form or not. "The symptoms," says Wood, "are sometimes at first exactly those of the catarrhal croup, and the difference is not detected until the voice begins to become whispering, and the cough to exchange its peculiar ringing or sonorous character for a husky sound. . . . Indeed, in the earliest stages, *before secretion has commenced*, it would be impossible to determine with certainty which form the disease was about to assume."² This distinction, therefore, if insisted upon, cannot be recognized till after exudation has occurred; nor even then, with any degree of certainty, in the majority of cases. The only certain diagnostic symptom of membranous croup is the expectoration of patches or tubes of false membrane. (Wood.) And this is said to occur in scarcely one-third of the cases. (*Rilliet and Barthez*.) While, therefore, we doubt the utility or propriety of considering cases in which false membrane is formed as a distinct variety of croup, we would urge the importance of not overlooking the fact of the possibility of its occurrence in any particular case, since such a result, especially if extending into the bronchial tubes, must necessarily increase the danger of the patient. The distinction most important to be borne in mind is that which relates to the type of the disease. Like all other inflammations, croup may be *sthenic* or *asthenic*, a distinction which ought never to be lost sight of, being not less important in a therapeutical than in a pathological point of view. The disease must also be more or less modified by the greater or less extension of the inflammation into the bronchial tubes, and by association or complications with other diseases. Not infrequently a bronchitis remains after the symptoms of croup have subsided, and this may even prove fatal at last.

It is now well known that inflammation of the laryngo-tracheal mucous membrane in adults, is sometimes accompanied by the formation of false membrane. The circumstances under which this result is most likely to occur will be alluded to further on.

M. Bretonneau describes under the name of *diphthérie*, or croup of adults, what he considers a specific form of inflammation of the mucous membrane of the throat and air-passages. It is generally attended with a low, typhoid, or adynamic state of system, and frequently proves fatal. It is generally an asthenic form of the disease, occurring chiefly in individuals already enfeebled and debilitated by previous diseases or epidemic influences. The false membrane in these cases almost always covers the tonsils and pharynx, descending from thence into the larynx and trachea. It is darker coloured and less firm than in sthenic croup.

Laryngismus alone, unassociated with inflammation of the mucous membrane of the larynx, has no pathological relation to croup, and therefore no claim to be considered a variety of that disease.

¹ "La présence de cette fausse membrane est la caractéristique anatomique fondamentale de cette affection. Sans ce produit nouveau, il n'y a pas de croup."—*Manuel Pratique des Maladies des Nouveaux-Nés*, etc. Par M. Bouehut.

² A Treatise on the Practice of Medicine. By George B. Wood. Art. "Croup."

Complications.—Perhaps the most dangerous complication of croup is with *cynanche maligna* either in its simple form, or in its association with scarlatina. This complication is not uncommon during epidemic visitations of that disease. The inflammation in such cases extends from the fauces to the pharynx and air-passages; and the false membrane, which is usually soft and of a dark or ash colour, often covers the tonsils and whole surface of the fauces and pharynx, extending more or less into the larynx and trachea also. It is generally attended with an adynamic state of system, and frequently with great fetor of the breath.

Croup is also not infrequently complicated with *cynanche tonsillaris* and the various forms of *angina*. In all these cases the affection of the air-passages is consecutive, the particular disease of the tonsils or throat preceding the characteristic symptoms of croup. Occasionally, croup is so frequently complicated with an epidemic of some one of these affections as to give it the form of an epidemic also.

The disease which has been described by Louis and others as croup in the adult was complicated with an affection of the tonsils and fauces.

Complication with *measles* is not uncommon. It may occur at any period of the disease from the commencement to advanced convalescence. It is sometimes mild and manageable, though occasionally severe and dangerous. We have seen it prove speedily fatal during the eruptive stage of the disease.

Complication with *smallpox* is said to be not uncommon. According to Copland, "it usually occurs in the more severe cases, particularly when the disease is confluent, and generally comes on slowly in the suppurative stage. In the more malignant cases, the difficulty of respiration is excessive; the voice very hoarse or suppressed; the paroxysms of suffocation are extreme; the cough dry or giving issue merely to a small quantity of dirty serum, or muco-sanguineous or dark sanguineous matter; and the attendant fever adynamic."

The complication of croup with *bronchitis* has already been alluded to (p. 104). When this complication exists, the bronchitis is consecutive, and the consequence of the extension downwards of the laryngo-tracheal inflammation. The inflammation may, perhaps, extend thus to the substance of the lungs and *pneumonia* supervene. Bronchitis or pneumonia thus supervening is not infrequently the cause of a fatal termination.

Anatomical Characters.—The mucous membrane is found red and tumefied, either continuously or in patches, over a greater or less extent of surface. The bloodvessels are injected, and there is often slight softening. Sometimes these appearances are confined chiefly to the larynx and upper part of the trachea, and, at other times, they extend over nearly the whole surface of the larynx, trachea, and bronchial tubes. The patches of redness sometimes occur in the form of rings passing round the trachea; sometimes extending lengthwise or irregularly. After the occurrence of the exudation, the inflammatory appearances of the mucous membrane are much less distinct; though they still remain in patches or streaks at least. Early in the disease the exudation upon the surface of the mucous membrane is scanty, viscid, and sometimes tinged with blood. Later, it is much more abundant and generally purulent. Patches and ribbons of false membrane are also generally found confined sometimes to the glottis, and sometimes lining more or less continuously the whole tract of the air-passages. It is said sometimes to have formed from the fauces to the last ramifications of the bronchi without any breach of continuity (*Bretonneau* and *Bricheteau*). Perfect tubes are

sometimes formed within the bronchi, the appearance of which has been compared by Dr. Cheyne to that of macaroni boiled in milk. And the exudation is sometimes so copious in the smaller bronchial tubes that they become filled with a solid cylinder of plasma. (*Peaslee.*) The consistence of the false membrane varies much in different cases, and also in the same case. In some cases it is quite firm, and in others so soft that it cannot be removed with forceps. It is generally firm in sthenic cases, and soft when it occurs in the asthenic; it is generally firmest also in the upper part of the trachea, and softest where it terminates below. Its colour is whitish or yellowish white; and its attached surface is often dotted over with numerous small specks of blood. Its thickness is differently estimated by different observers, but probably seldom exceeds a line and a half. It is thickest upon the posterior and superior wall of the trachea. It is believed that two or more membranes have sometimes formed successively on the same surface. The false membrane sometimes adheres with considerable firmness; but more frequently it is partially detached, and has beneath it more or less muco-purulent matter. Upon the removal of the false membrane, the mucous membrane beneath it is seldom found to exhibit signs of severe inflammation; and not infrequently has nearly a healthy appearance, even when covered with a thick, concrete membrane. Upon this point, Dr. Ryland observes: "It happens but very rarely that we have an opportunity of examining the state of the membrane in the first period of croup, before the formation of the albuminous concretion; and it is on this account, in a great measure, that we seldom find any vivid injection of the parts, for the secretion of the lymph weakens the inflammation most commonly, and in the end puts a stop to it entirely." In many cases, however, no false membrane is found. In such cases, the mucous membrane is generally found covered with a considerable quantity of puriform matter. In some cases, terminating fatally in a few hours, it seems as though death had occurred before sufficient time had elapsed for the exudation to become converted into a false membrane.

Nature and Pathology.—Croup has been considered by most writers as essentially different from inflammation of the same parts occurring in the adult; and, from its more frequent tendency to the formation of false membrane, has been supposed to possess a specific nature. Our own views upon this, and some other important practical points in relation to the nature and pathology of this disease are comprised in the following propositions, which we shall endeavour to substantiate as we proceed:—

1. Croup is always an inflammation of the mucous membrane of the larynx and trachea.
2. The inflammation may be sthenic or asthenic.
3. The inflammation is invariably accompanied by an exudation of the plasma of the blood from the vessels of the part, and upon the surface of the membrane; which exudation becomes organized into a false membrane in about one-sixth of all the cases.
4. This exudation is not essentially different from that which occurs upon the same membrane when in a state of inflammation in the adult; nor from that which occurs upon other inflamed mucous or serous membranes.
5. The exudation relieves more or less completely the inflammation which has produced it.

¹ Diseases and Injuries of the Larynx and Trachea. By F. Ryland, p. 184.

6. The false membrane, when formed, never becomes vascular; and therefore soon loses its slight vitality, becomes detached and spontaneously falls off.
7. The inflammation commences generally in the fauces—sometimes in the larynx; but, at whatever point it may commence, it extends *always downwards, never upwards.*
8. The inflammation is uniformly attended with more or less laryngismus; and this, in the majority of cases, first shows itself during sleep.
9. The presence of the false membrane does not constitute the sole or chief danger in croup.

1. That croup is an inflammation of the lining membrane of the larynx and trachea is too generally admitted to make it necessary for us to dwell upon it. Those writers, even, who insist most strongly upon the pathological difference between cases in which false membrane is formed, and cases in which it is not, consider both classes of cases inflammatory; the difference insisted upon being a peculiar element in the inflammation in the former, which causes a plastic exudation. Dr. Ware gives to the former the name of *membranous*, and to the latter the name of *inflammatory* croup. Dr. Wood calls the former *pseudo-membranous*, and the latter *catarrhal*; saying, in explanation, that in giving it the name of *catarrhal croup*, he wishes to be understood merely as indicating that the inflammation is of the same general nature as that which occurs in catarrh. But the increased secretion from a mucous membrane constituting catarrh is not the result of inflammation at all, but of simple congestion, or irritation, or both. If this congestion or irritation passes into inflammation, the catarrhal secretion is at once arrested, and plasma is exuded upon the surface of the membrane (*Hæse*). Whether this exudation becomes converted into a false membrane or not will depend upon other circumstances which will be considered hereafter. That by *catarrhal inflammation* Dr. Wood means not simply the congestion and irritation of catarrh, but actual inflammation, is clearly shown by the following extract from his description of catarrhal croup: "Dissection exhibits redness of the mucous membrane of the larynx, trachea, and bronchia, either in patches or continuous, with occasional swelling of the submucous tissue from inflammatory infiltration, and more or less mucus in the air-passages, which, if death has taken place early, is scanty, viscid, and adherent to the sides of the tubes; if in the more advanced stages, is more abundant and often purulent. Occasionally, patches of adhering false membrane may be detected, but insufficient to have had any agency in the fatal result." The inflammation may be confined to the larynx and trachea; but it sometimes extends over the whole surface of the air-passages; and the extent of membrane affected may be of any degree between these two extremes.

2. The inflammation may be either *sthenic* or *asthenic*. The importance of this distinction has been already noticed. The character of this, as of other inflammations, is dependent chiefly upon the condition of the patient and upon epidemic influences. As a general rule, in robust and plethoric children the disease assumes a *sthenic*, and in the feeble and debilitated, an *asthenic* type; while between these two there may be many intermediate grades. The effects of epidemic influences upon the character of this, in common with other diseases, are important, and should be constantly borne in mind.

3. That the inflammation of croup is uniformly accompanied by an exudation of the plasma of the blood is admitted on all sides in respect of all cases in which a false membrane is formed. The fact that most writers recognize

two varieties of croup, one characterized by the presence of false membrane, and the other by its absence, and both presenting the most positive evidences of inflammation of the mucous membrane of the larynx and trachea, shows conclusively that inflammation of that membrane does occur in the child without the formation of a false membrane. Indeed, such a result is found to occur in only a small proportion of all the cases. And it is well established that inflammation of the same membrane in the adult is sometimes—though much more rarely—followed by the formation of a false membrane also.

It becomes, then, an important point in the pathology of this disease, to determine whether the false membrane, in cases in which it occurs, is due to a peculiar and distinctive form of inflammation, characterized by a peculiar and plastic exudation; or, whether it is altogether the result of accident, or a combination of fortuitous circumstances, the same exudation, essentially, occurring in all the cases. The former of these opinions has been generally maintained; but the latter we consider most consonant, both with facts and analogies. If we examine the facts in the case, we find, 1st. That many cases not at all distinguishable for any practical purpose from membranous croup, and which are diagnosed and treated as such, run their whole course, either to recovery or a fatal termination, without presenting any positive evidence of the presence of a false membrane at any period of their course. We attended a case of croup a short time since, during almost the whole course of which there was complete loss of voice. Convalescence commenced during the third week, but the child was not able to speak above a whisper till some time later, and a considerable degree of hoarseness remained for several weeks. There was no appearance of false membrane either in the expectoration or matters vomited during the course of this case. Moreover, post-mortem examinations of fatal cases sometimes fail to reveal the presence of a false membrane in the air-passages. It is, therefore, at least probable that, in some cases not distinguishable from membranous croup during life, no false membrane at all is formed. On the other hand, it is well known that cases not considered membranous, when terminating fatally, present not unfrequently, upon examination, more or less extensive patches of false membrane. Dr. Wood says, in describing the anatomical characters of "catarrhal croup," that "occasionally patches of adhering false membrane may be detected, but," he adds, "insufficient to have had any agency in the fatal result." And M. Guersent found, on dissection, in the larynxes of young children who had died of what had been considered "spasmodic croup," "albuminous concretions, sometimes extensive, but more frequently consisting of small isolated patches."¹

2d. Where expectoration occurs, it is essentially the same in both classes of cases; being, in the earlier stages of both, stringy, glairy, and adhesive, and not unfrequently tinged with blood; and becoming generally, except perhaps in cases of very slight duration and severity, purulent as the disease proceeds. In relation to the post-mortem appearances of cases in which no false membrane is found, Copland says: "In the very few opportunities I have had of examining the state of parts in the more purely spasmodic cases of croup, an adhesive, glairy fluid, with patches of vascularity, were observed in the epiglottis and larynx."² There can be little doubt, we think, that this "adhesive, glairy fluid," is present upon the inflamed membrane in all cases of croup; and that it is the same plastic exudation as that which in some cases

¹ See Copland's Dictionary of Practical Medicine. Article "Croup."

² Copland's Dictionary of Practical Medicine. Art. "Croup."

becomes concentered into a false membrane. The purulent matter which is found upon the mucous membrane in the later stages of all cases, is the result of a degeneration of the exudation corpuscles of the exuded plasma. Not only are these conclusions necessary to a satisfactory explanation of the preceding facts, but they derive confirmation also from their analogy with what is known to occur in other diseases. Perhaps no fact in pathology is better established than that inflammation of serous membranes is uniformly attended by an exudation of the plasma of the blood from the vessels of the part, and upon the surface of the membrane. In acute inflammation of a serous membrane, this exudation takes place in a few hours (*Williams*). The exuded plasma in these cases may become organized into a permanent false membrane; but this result is by no means constant; it occurs only in a minority of all the cases (*Pearse*). So far, then, we see a very exact analogy between the inflammation of serous membranes, whether occurring in the infant or adult, and the inflammation of croup. Both are attended uniformly by an exudation of the plasma of the blood; but in neither does the exuded plasma become uniformly organized into a false membrane. If the exudation becomes oftener and more perfectly organized in inflammations of serous membranes than in croup, many reasons occur to us why it should be so. In the case of inflammation of a serous membrane, the exudation is in close contact with the living membrane on both sides, being separated only by a delicate layer of scaly epithelium; it is completely protected from the influence of air and other foreign bodies; and it is maintained in a state of comparative rest for a considerable length of time. All these circumstances are most favourable to the result of organization. In croup, on the contrary, one side only of the exudation can be in contact with the living membrane, the other being exposed to the constant action of the air in breathing. Moreover, the mucous membrane of the air-passages is covered with a conoidal instead of a delicate scaly epithelium, and the necessary contact of the plasma with the living membrane is constantly liable to interruption from cough and other motions of the parts. If, then, under a combination of circumstances so favourable to such a result, inflammation of serous membranes produces false membranes in only a minority of all the cases, we certainly need not wonder that the inflammation of croup should produce them in a still smaller proportion; though plasma be exuded in every case. Nor need we be surprised, on the other hand, that in a small proportion of the cases such a result should occur.

Dr. Horace Green,¹ after having maintained that all the so-called varieties of croup are pathologically and practically one and the same disease, and that the essential elements of the disease are inflammation of the mucous membrane of the air-passages and its accompanying plastic exudation, endeavours to prove that the plastic material "is secreted by the muciparous glands which so abundantly stud the larynx and trachea." The chief arguments in support of this theory, are, that the false membrane is uniformly thickest and most perfectly formed wherever these glands are most numerous; and that, as observed by Hasse, "filamentous bands are sometimes found between the plastic exudation and the mucous membrane, consisting merely of delicate fibrous threads, which dip into the orifices of the muciparous glands." That the exudation should be most abundant, and therefore the resulting membrane thickest where these glands are most numerous, is satisfactorily explained by the fact, that these follicles being merely an inversion of the mucous membrane, there is a much greater amount of free surface, and

¹ Observations on the Pathology of Croup, etc., pp. 14-16.

a much greater number of bloodvessels inclosed in the same space than elsewhere. This also readily explains the fact observed by Hasse. Moreover, we do not think that any established physiological or pathological phenomena can justify us in supposing that either mucous follicles or any other secreting organs have ever, under any circumstances, the power of separating organizable fibrin from the blood.

The proportion of all the cases of croup in which a false membrane is formed is about one-sixth. Of 131 cases observed by Dr. Ware, 22 were cases of membranous croup. Still it is impossible in the commencement of any case to tell whether such a result will follow or not. We may be certain at the commencement in every case, that plasma will be exuded upon the surface of the membrane. In adults, the plasma thus exuded is usually at once removed by coughing; but in infants and young children, this is not so. If the inflammation occur in a plethoric child, whose blood is rich in fibrin, and there is little cough, the danger of the formation of a false membrane becomes increased. The exudation of the inflammation of a serous membrane may be entirely absorbed; but this is probably seldom, if ever, the case with the exudation of an inflamed mucous membrane. But instead of becoming formed into a false membrane, it may, by a degeneration of its exudation corpuscles, become converted into pus, and thus removed. And this result actually occurs in a majority of the cases. The amount of the exudation, and hence the thickness of the resulting membrane is influenced by the degree of the inflammation and the vascularity of the part. It is generally thickest, for reasons already stated (p. 111), on the posterior and superior wall of the trachea.

4. The exudation of croup is not essentially different from that which occurs upon the same membrane when in a state of inflammation in the adult; nor from that which occurs upon other inflamed mucous or serous membranes. In other words, the exudation of the plasma of the blood occurs, not only in all cases of croup, but also in all cases of inflammation of membranes both mucous and serous.

The fact that false membrane does sometimes form in the laryngitis of adults has before been alluded to (p. 109). It is also well known that false membranes have been formed in cases of inflammation of the rectum, the vagina, the uterus, the nasal passages, and the pharynx. In all these cases we are forced to admit the presence of precisely the same kind of exudation as occurs in croup; since "a false membrane is in all cases formed from the plasma of the blood" (*Peaslee*). Laryngitis in the adult is rarely accompanied by the formation of a false membrane for the reason that the exudation is usually at once removed by coughing. When it is so accompanied, it is generally in persons who either from habit or inability do not expectorate at all (*Peaslee*). But aside from external circumstances and influences, the result of organization of the exuded plasma is, doubtless, influenced by the condition of the blood from which it is derived. In all inflammations the organizability of the exudation is probably proportionate to the amount and plasticity of the fibrin in the blood. Now it is well known that in inflammations of serous membranes, the fibrin of the blood is increased in a greater proportion than in inflammations of mucous membranes. The external conditions under which the plasma is exuded in the former, are also more favourable to the result of organization than are found to exist in the latter, as already shown (p. 111). Hence, as we should expect, inflammation of serous membranes is more frequently productive of false membrane, than is inflammation of mucous membranes. It is also well known, "that all the

formative processes are in much less time completed in the young than in the adult animal; and it is in accordance with this ultimate fact, that Jurine and other experimenters could artificially produce false membranes in the air-passages of young animals alone. In adult animals, the exudation would become detached before its organization was complete.¹⁴ We believe this to be the chief reason why inflammation of the air-passages is productive of false membrane so frequently in children, and so rarely in adults. The time required for the organization of the exudation is much less in the child than in the adult; and the probability of its being removed before organization is complete is also much less, since young children do not expectorate at all.

But false membranes do sometimes form in inflammation of the air-passages in adults, and also in inflammation of the mucous membrane of other parts, as already mentioned (p. 112). And wherever this result occurs, it will be found that the combination of circumstances already noticed as favourable to such a result has obtained. It may therefore, we think, be safely asserted that the apparently different results of inflammation of the air-passages in children and in adults, offers nothing incompatible with the proposition that the exudation is alike in both; but that they are rather precisely what we should expect from a consideration of the respective conditions present in the two classes of cases. For the same reason, we should infer also that the occasional formation of false membranes in inflammation of the mucous membrane of other parts, was rather the result of a fortuitous combination of circumstances than of a peculiar exudation.¹⁵

As confirmative evidence in support of this proposition, it may also be cited that the microscopical researches of Gerber, Henle, and others, established long ago the uniform presence of exudation corpuscles upon inflamed mucous membranes.

5. The exudation relieves, more or less completely, the inflammation which has produced it. This we believe to be true of all inflammations, but more especially so of all inflammations of membranes. The engorged vessels are relieved by the exudation; the circulation is again freely established; and thus the inflammatory action is terminated. Upon this point Dr. Ryland says: "The secretion of the lymph weakens the inflammation most commonly, and in the end puts a stop to it entirely."¹⁶ And Dr. Peaslee remarks, that the "exudation always at once puts a stop to the inflammatory process in the precise part where it occurs, but it does not necessarily preclude its return in the part."¹⁷ This proposition is of practical importance. After exudation has occurred and the false membrane formed, it is no longer inflammation with which we have to deal, but its results. And hence the depletive treatment, so proper and beneficial at first, becomes now improper and useless, if not absolutely injurious. The fact should be borne in mind, however, that the inflammation may extend *downwards* after exudation has occurred in the larynx and trachea.

6. It is an important fact that the false membrane formed from the exudation of an inflamed mucous membrane, never becomes *vascular*. In this

¹⁴ A Monograph on the Pathology and the Rational Treatment of Croup. By E. R. Peaslee, A. M., M. D., p. 6.

¹⁵ Dr. Peaslee says: "It was remarked several years ago by Dr. Alison, that there is in all inflammations, a tendency to the exudation of plasma from the vessels of the inflamed part. We maintain that in all inflammations an exudation actually does occur." (*Monograph on Croup*, p. 5.)

¹⁶ Diseases and Injuries of the Larynx and Trachea, p. 134.

¹⁷ Monograph on Croup, p. 11.

respect, there is an important difference between a false membrane, formed upon a mucous membrane, and one formed upon a serous membrane. The latter, as is well known, often becomes vascular and permanent; the former never becomes so; and it is therefore impossible for its connection with the mucous membrane to be maintained for a long period of time. Sooner or later its vitality will cease; pus will be formed between it and the mucous membrane by the degeneration of exudation corpuscles, and the false membrane will be gradually loosened and cast off. This result will certainly occur if the patient's strength hold out sufficiently long. The time necessary for its completion will vary in different cases, but will not probably exceed a week. It is probable that the false membrane is not thrown off in a perfect state, so as to be recognized as such in every case in which it is formed; but that it may sometimes become converted into pus, and in this state be removed.

7. The inflammation commences generally in the fauces; sometimes in the larynx; but at whatever point it may commence it extends *always downwards, never upwards*. This fact is now well established by the observations of Rokitansky, Hasse, and other eminent pathologists. Its important therapeutic bearing will be at once seen, when we reflect that a fatal termination is often brought about by an extension of the inflammation to the smaller subdivisions of the bronchi. It becomes, therefore, an important point in the treatment of croup, to arrest the inflammation before it has extended to the bronchial tubes. The earlier the inflammatory process is arrested, the more nearly will the exudation be confined to the larynx and trachea; and the more reason shall we have to hope that, if it becomes organized, it will not sufficiently interfere with respiration to endanger the life of the patient.

8. Laryngismus is a constant attendant upon croup, and increases in no small degree the distress and danger of the disease. Whatever may be the true explanation of the fact, its first accession occurs, in the majority of cases, during sleep, and generally in the early part of the evening. This fact is supported by the uniform testimony of almost all who have written upon the disease, and must, we think, coincide with the observations of every practitioner. The accession of the laryngismus does not probably coincide precisely with the commencement of the inflammation. This may, and generally does exist, for a longer or shorter time before laryngismus is excited. The condition of sleep seems to offer something favourable to its accession; so that a degree and amount of inflammation insufficient to excite it in the waking state, becomes sufficient to do so during sleep. The appearance of the laryngismus is generally considered as marking the commencement of the disease; yet we think it will be found almost uniformly, that more or less febrile action has been present for, at least, several hours preceding its accession. The laryngismus, when once excited, is never entirely absent throughout the disease; but is subject to exacerbations and remissions. Exacerbations frequently occur during the day, but oftener at night. The tendency to nightly exacerbations is usually marked, and probably depends upon the same causes as determine its first accession at this period. This marked tendency to nocturnal accession and aggravation of the laryngismus, is thus ingeniously explained by Dr. Robert Turner.¹ The stridulous respiration and croupal cough are owing to contraction of the rima glottidis. The superior laryngeal is the excitor, and the recurrent laryngeal, with the crico-thyroid branch of the superior laryngeal, the motor nerves, which constitute the circle by which the aperture of the glottis is governed.

¹ Braithwaite's Retrospect, part xxx. p. 264.

Inflammation of the mucous membrane alone, or combined with any of its consequences, is capable of producing contraction of the glottidean muscles, through the excito-motor circle above named.

"In every form, case, and stage of laryngo-tracheal inflammation, when a degree of severity, of which stridulous respiration is the token, has been attained, there exists a structural lesion which will excite to action the constrictor muscles of the glottis."

The following explanation of the proclivity to nocturnal invasion and aggravation of the laryngismus flows from the preceding positions: "Volition," says Dr. Marshall Hall, "has a constant influence over some of the muscular actions, of which we are almost unconscious, and which we only discover by carefully observing the effects of its subtraction. The acts of respiration originating, as they do, in the reflex function of the spinal cord, are nevertheless regulated and rendered equable by this silent but constant influence and agency of volition." Hence, during sleep, when the regulating and equalizing influence of volition is suspended, the glottidean contraction is excited by a degree of inflammation in the laryngeal mucous membrane incapable of exciting it, when the glottidean muscles are under the control of the cerebral system. The laryngismus is an important element in croup, both in a pathological and semeiological point of view. In some rare cases, the life of the patient is terminated at once, by a severe and long continued paroxysm. And in all, the laryngismus is an important agent in producing the obstructed respiration and fatal asphyxia. Dr. Williams says, upon this point: "The share which spasm has in causing the dyspnoea (of croup) may be inferred from the fact, that in no case have the air-passages been found so much blocked by the albuminous secretion as to account for the amount of the obstruction; and in many cases the constriction has appeared greatest where little or no exudation was found after death."¹ Dr. West also says, that the spasmodic condition of the muscles of the glottis endanger the patient's life more than the mere extent of false membrane in the air-passages. The laryngismus interferes with respiration, both by obstructing the ingress of air to the lungs directly, and by preventing expectoration. "Much of the inflammatory products, solid and fluid, which accumulate in the trachea and bronchi in protracted cases, would doubtless be ejected, if a more patent state of the orifice existed throughout the attack."

9. The presence of the false membrane has been considered by many as constituting the chief danger in croup; and the leading indication in treatment, therefore, to procure its expulsion. That the false membrane alone, when confined to the larynx and trachea, would never of itself produce a fatal termination is proved by the observations of Williams and others, before mentioned. It is also well known to every one at all conversant with the post-mortem appearances in this disease, that in many cases false membranes are found insufficient in amount or extent, to have had any agency in the fatal termination. It is also well known that expectoration of tubes of false membrane is by no means always followed by recovery. Acute laryngitis is a serious and fatal disease when occurring in the adult, although then generally unaccompanied by false membrane. We need not wonder, then, that inflammation of a part which is so often sufficient to destroy the life of the adult, should also be sufficient to destroy the life of the child, and that independent of any accidental complications or consequences. It ought not to be overlooked, that the presence of the false membrane, especially when

¹ Treatise on the Diseases of the Respiratory Organs, p. 142.

extending to the smaller bronchial tubes, increases the danger of the patient. Neither ought it to be overlooked, that its presence is not the only or chief cause of the obstructed respiration, and that its removal, however secured, is by no means uniformly followed by recovery or amendment.

Causes.—The most frequent cause of the disease is, no doubt, exposure to cold, or to cold combined with moisture. Vicissitudes of weather and of temperature, have considerable influence in producing it. In infants, the disease is said to be often occasioned by sleeping in very cold chambers after having been all day in hot rooms. It is said to be most prevalent in localities which are low and moist. A cold and moist wind, especially when alternating suddenly with a dry and warm one, has considerable agency in producing the disease. It occurs at all seasons of the year, but is most frequent in those that are cold, and subject to sudden and marked variations in temperature. Probably three or four times as many cases occur during the six months between October and May, as during the remaining six months of the year.

The narrowness of the larynx during infancy and childhood has, no doubt, great influence in causing the laryngismus. The disease, although not absolutely confined to any age, is most common between the first and seventh years. It often occurs, however, during the first year, and after the seventh. M. Doges has seen it in an infant a few days old. Home says the earlier children are weaned, the more liable they are to the disease; and Copland states that he has seen it much the most frequently at the early age of three, four, five, and six months in children which have been brought up by hand; and in a still greater number of instances at from seven months to upwards of a twelvemonth in those which have been recently weaned. Our own observations accord with this.

The disease occurs more frequently in boys than in girls. Jurine treated ninety-one cases previous to 1808, fifty-four of which were boys, and thirty-seven girls; and during 1808, twenty-eight, of which eighteen were boys and ten girls. Goelis treated two hundred and fifty-two cases of the disease, one hundred and fifty-four of which were boys, and one hundred and eight girls.

And of four hundred and twenty-nine which died of croup in Massachusetts during 1852, two hundred and forty-three were boys, and one hundred and seventy-eight girls; the sex of eight not being reported.

There can be no doubt that both the frequency and type of the disease are modified by epidemic influences. A distinctly epidemic form of the disease was observed by Baillou, in Paris, in 1576; by Ghisi, at Cremona, in 1747; by Starr, in Cornwall, in 1748; by Rosenstein, in Upsal, &c., in 1762; by Van Bergen, in Frankfort, in 1764; by Wahlborn and Baeck, in some parts of Sweden, in 1768 and 1772; and by various observers during the present century, both in Europe and the United States.¹

Several authors have maintained that the disease may occasionally prove infectious. Such cases are probably the result of the same causes, acting upon similar states of susceptibility and disposition.

The disease is unusually prevalent in certain families, and hence Cheyne and some others conceive the existence of an hereditary tendency in the disease. This is, however satisfactorily explained, as remarked by M. Desruelles, by the susceptibilities of age and temperament, being often necessarily the same in several of the same family; and by their being exposed to the same agents, and placed under similar circumstances.

¹ Copland's Dictionary of Practical Medicine, vol. i. p. 530.

Copland ranks among the most frequent causes of the disease, the retrocession of eruptive diseases, and the suppression of other eruptions, or of discharges, secretions and excretions.

Diagnosis.—The diagnosis of the disease, though in general easy, is not always so. It is, perhaps, most liable to be confounded with simple laryngismus and catarrh. It is exceedingly desirable in respect of all classes of cases, that a correct diagnosis be formed as early as possible. "We are decidedly of the opinion," says Prof. Peaslee, "that if the usual 'perturbing' treatment of the disease (croup) is to be carried into execution, the little patient's prospect of ultimate recovery will, in most cases, be at least as good, if we commit the mistake of deciding that the disease does *not* exist when it actually does, and thus give the patient the chance of recovery without any medication at all, as if we err in the opposite direction, and therefore apply the treatment, although there is no serious disease at first."¹ Attention to the following points, however, will generally enable us to distinguish croup from the diseases above mentioned.

Laryngismus is sudden in its accession, and as sudden in its cessation. It is not accompanied by fever. The respiration during the attacks often resembles almost exactly that of croup; but is entirely free from stridor between them. There is no hoarseness of voice, or croupal cough during the interval, though both may be present during the attack. There is no redness of the fauces.

In *croup* the attack is more gradual, and the cessation never sudden. The stridulous inspiration and croupal cough, though often apparently sudden in their accession, are generally preceded, for a few hours, at least, by symptoms of general indisposition, with more or less fever; and often for two or three days by catarrh. The stridor of inspiration may also be detected by the stethoscope or ear, applied directly to the larynx, before it becomes audible at ordinary distances. Inspiration retains, in a greater or less degree, its stridulous character between the paroxysms; and the croupal cough and hoarseness of voice are never absent in the course of the disease. There is generally fever. The fauces are usually injected, and sometimes covered with patches of false membrane.

The condition of the patient and "the prevalent medical diathesis" of the time will also aid somewhat in the diagnosis, in doubtful cases. If in a doubtful case we ascertain that the patient, or an older child in the same family, has had previous attacks of laryngismus, with similar symptoms, and croup be not particularly prevalent at the time, we may calculate with considerable certainty that the disease is not croup. In such cases, an emetic of ipecacuanha will usually remove at once all unpleasant symptoms. In *catarrh* there may be hoarseness of the voice, redness of the fauces, and cough. But the respiration, though hurried, is not *stridulous*, and the cough has not the peculiar character of that of croup. There is usually no fever.

Prognosis.—A favourable termination may be expected when the form of the disease is mild, the frequency of the pulse moderate, and the respiration comparatively quiet. Still the physician cannot be too strongly impressed with the fact that no case of croup is devoid of danger. In more severe forms of the disease, when about to terminate favourably, the pulse becomes less frequent, respiration easier, the cough looser, followed by viscid expectoration

¹ Monograph on Croup, p. 18.

containing often fragments of membrane, and the voice more natural. The urine, also, becomes more copious and of a paler colour. Occasionally, a copious perspiration seems to mark the commencement of a return to health.

We have reason to fear a fatal termination when there is great frequency of pulse and heat of skin early in the disease, with great difficulty and stridor of respiration. When, notwithstanding treatment, the urgency of the symptoms increase; when the countenance becomes livid, or the lips purple and the cheeks pale, tumid, and cold, the pulse very frequent, weak, and irregular, and the patient stupid and drowsy, showing that the vitality of the nervous centres is failing for want of their due supply of oxygenated blood, a speedily fatal termination may be anticipated. The prognosis will also be modified by the presence or absence of complications with bronchitis, pneumonia, or other diseases; such complications, although not necessarily fatal, adding greatly to the danger of the patient.

Treatment.—The indications in the treatment of croup, as founded upon the preceding views of its nature and pathology, are as follows:—

- I. To subdue the inflammation.
- II. To moderate the laryngismus.
- III. To prevent the formation of a false membrane.
- IV. To produce the discharge of the false membrane when formed.
- V. To support the patient's strength.

I. *Remedies for subduing the Inflammation.*—In our selection of remedies for this purpose we shall be governed somewhat by the age of the patient and the general type of the disease. Whilst the treatment should in all cases be prompt and judiciously vigorous, the delicate age and susceptibilities of the patient ought never to be lost sight of. In sthenic cases of croup, where febrile action is high, and before it has been moderated by the occurrence of exudation, *bloodletting*, either general or local, may be resorted to. This remedy, however, is not appropriate in asthenic cases, nor in sthenic cases generally after the exudation has been poured out. Should the febrile action, however, continue high after exudation has occurred, indicating an extension of the inflammation downwards in the air-tubes, and the sthenic type of the disease be well-marked, the abstraction of blood may still be beneficial. The general fact, however, should be remembered that very young children bear the loss of blood badly. We would not advise *general* bloodletting in a patient under six years of age. If the patient be six years old or over, and robust and plethoric, and febrile excitement high, venesection may be resorted to with safety and advantage. In younger patients, where bloodletting is indicated by the severity of the symptoms and the sthenic character of the disease, it should be done locally by the application of leeches or cups. One or more cups may be applied between the shoulders, or to the nape; or two or three leeches to the top of the sternum or throat. In either case the quantity of blood taken should be carefully adapted to the age and condition of the patient. An ounce or an ounce and a half for each year the patient has completed will generally be borne. The value of this remedy has been variously estimated by different writers. With due regard to the character of the cases to which it is applied, we consider it a valuable remedy in fulfilling this indication; but neither general nor local bloodletting should be resorted to in any case in which they are not clearly indicated.

Turtrate of Antimony.—This is a remedy of great power and efficiency in fulfilling this indication. In many cases in which bloodletting would other-

wise be indicated, this may be so administered as to form a safe and valuable substitute. It should be given in small doses, frequently repeated, so as to maintain a constant and steady sedative effect upon the circulation. It is generally proper to begin with doses of one-thirtieth to one-twentieth of a grain dissolved in water every hour or two, for a child one year old. For a child three or four years old the dose may be increased to one-fifteenth or one-tenth of a grain; the quantity given may be increased or diminished according to the effect produced. When administered in this way, its action upon the circulation is generally prompt and decided. The skin becomes cooler and the pulse slower and softer. The amount and frequency of the dose may be increased or diminished, as is found necessary to secure and maintain this effect.

In administering this remedy, it should be borne in mind that severe prostration is sometimes produced by it in very young children, and in those of a debilitated constitution. In all cases the patient should be carefully watched, and, upon the first appearance of prostration or diarrhoea, the medicine should be diminished or altogether withheld till the symptoms again indicate its repetition. It is not uncommon for diarrhoea to occur suddenly during its administration, and this diarrhoea it is sometimes exceedingly difficult to check. The stools are peculiarly watery and without odour. "An infant six months old has been destroyed by one-thirtieth of a grain of this remedy, and another barely escaped with life after taking, in three doses, sixty drops of the hivo syrup." (*Peaslee*.) In the majority of cases of sthenic croup, this remedy cautiously administered, as already advised, constitutes our main dependence, so far as internal medication is concerned, for arresting the inflammation. But it is not well borne in asthenic cases, and in those of a more sthenic type, after exudation has occurred and the febrile excitement somewhat subsided; it should generally be given in diminished doses. If vomiting is produced by the remedy, its sedative effect is diminished. We consider it, therefore, more efficient in controlling the inflammation when its administration is so regulated as not to produce this effect. The addition of opium in very small doses increases the tolerance of the medicine.

When a sufficient amount of the medicine to produce the desired effect upon the circulation is not borne by the stomach, and opium is not contraindicated, we are in the habit of adding one-half a drop, or more, in proportion to the age of the patient, of tincture of opium to each dose. The same addition may also be made when called for to diminish the action of the antimony on the bowels. This remedy has been used and recommended by some in very large doses in this disease. The largest quantity we have ever seen asserted to have been given, is in a case reported by Prof. Mettauer, of Baltimore, in the *Boston Medical and Surgical Journal*, vol. xiv. To a child about nineteen months old he gave, in a little more than two hours, the enormous amount of *half an ounce*, with as much ipecacuanha and antimonial wine.¹ Recovery

¹ The following extract from Prof. Mettauer's "Case of Protracted Croup," shows the manner in which the remedy was administered. After describing the condition of the patient and the preliminary step of moistening the mouth, he says: "I next carefully introduced into the stomach, with a teaspoon, a mixture composed of five grains of tartar emetic and ten of ipecacuanha, rendered semifluid with antimonial wine. This effort was finally successful, but the accomplishment of it was exceedingly difficult. A second dose of the medicines, mixed in the same manner, only augmenting the proportion of tartar to twenty grains, was quickly prepared and administered. After this attempt, a third and succeeding doses were prepared and administered in rapid succession; and I was now emboldened to give a heaping teaspoonful of tartar at each dose, only employing the ipecacuanha and antimonial wine in quantities sufficient to

followed; *post hoc, ergo propter hoc*. Prof. Mettauer remarks, and we think very appropriately, that this case "*furnishes new evidence of the astonishing resources of the infantile constitution, and its tenaciousness of life.*" We are no advocate for what is generally termed "*heroic treatment,*" and especially when the subjects are young children. Large doses of antimony are, in our opinion, unsafe and unnecessary in the treatment of this disease. The object is to produce and maintain a decided sedative impression upon the circulation without producing prostration. And this we believe to be best secured by administering the remedy in small and frequently repeated doses.

Lobelia Inflata.—When the tartrate of antimony, administered as above advised, causes troublesome diarrhœa, we have found the lobelia a valuable substitute. We believe it to approach more nearly in its operation to the tartrate of antimony than any other remedy we possess. It is a powerful remedy, and should be cautiously administered. We are in the habit of prescribing both the ethereal and the alcoholic tincture. Either may be given to a child one year old in doses of five or six drops every two hours, and the quantity or frequency of the dose may be increased or diminished according to the effect produced. With older children larger doses may be commenced with; but, in all cases, it is best to begin with moderate doses, and increase the quantity gradually, if necessary, to produce the desired sedative impression. Should symptoms of prostration be produced by the remedy, it must be at once withheld; and when the circulation again rises, smaller doses may be administered. It should not be given in asthenic cases.

Nitrate of Potash.—The sedative properties of the nitrate of potash are slight compared with those of the remedies already mentioned. It cannot, therefore, in any case be relied upon for arresting the inflammatory process. In asthenic cases, however, in which either of the preceding remedies would be deemed hazardous, and also in cases in which, from great irritability of the intestinal canal they cannot be borne, this remedy may be given; but rather as an auxiliary to remedies hereafter to be noticed, than as a chief means of arresting the inflammation. It may be given in doses of one or two grains dissolved in water, every two hours, to a child one year old.

Cathartics.—Early in the disease, if the bowels are not freely open, it is generally advisable to administer a gentle cathartic. By removing from the bowels all retained secretions and excretions, and, also, by relieving congestion of the portal circulation when present, we may expect to exert, indirectly, a favourable influence upon the course of the disease. From three to five grains of calomel is, probably, the best cathartic that can be exhibited for this purpose. Should it not operate sufficiently, it may be followed in a few hours by castor oil.

Emetics.—An emetic administered at the commencement of the disease seems sometimes to have the effect of arresting it at once. It is only, however, in the forming stage of the disease that such an effect can be expected. After the disease is fully formed, the repeated exhibition of emetics can only do harm.

When an emetic is indicated, ipecacuanha may be used, combined, in sthenic cases, with tartrate of antimony, and, in asthenic cases, with sulphate of zinc.

suspend and render fluent so large a portion of the tartar. In this manner I proceeded, though not without much difficulty, and with fear and trembling lest the little patient might strangle, until the full contents of a half ounce vial of tartar emetic, and the same quantities of ipecacuanha and antimonial wine had been employed, requiring something more than two hours time for the accomplishment of this bold undertaking." (*Boston Medical and Surgical Journal*, vol. xiv. p. 102.)

The *symplicum scillæ compositum* is an excellent article for this purpose in many cases. Thirty or forty minims may be given to a child two years old, and repeated every fifteen or twenty minutes till vomiting is produced.

External Application of Cold.—This is considered, by some writers, less beneficial than warm fomentations. Goelis considered it a dangerous application. We are aware that, to be beneficial, it must be continuously applied. Unless this point be secured, it will do more harm than good. Judiciously applied, however, we consider it a valuable aid in fulfilling this indication. We generally make the application by suspending a small pail, nearly filled with water, over the throat of the patient, and hanging a few small strips of cotton cloth over the edge of the pail so that one end may be immersed in the water. In this way, a continuous dropping is obtained. One, or, at most, two layers of cloth are laid upon the throat to receive it. Care should be taken that the patient's clothes and bed do not become wetted by the operation. If more convenient, the water may be constantly dropped from a sponge upon the throat. The compress upon which the water is dropped should be thin; that evaporation may go on rapidly.

Applications internally to the Seat of the Disease.—Topical medication, in this disease, is of comparatively recent origin, not reaching back, at most, beyond fifteen years. Its great value and importance, however, are now fully established. The most efficient local application is, beyond doubt, a solution of the nitrate of silver. The value of this remedy as a local application in certain forms of inflammation has long been recognized and acknowledged by the medical profession generally. The first, we believe, to recommend its use in croup was M. Bretonneau. Guersent, Guet, Bouchut, and other French practitioners, also recommend the same application. The strength of the solution used by M. Bretonneau was four grammes of the salt to thirty-two grammes of water; whilst M. Bouchut used ten grammes of the salt to thirty of water; and M. Guet a still stronger solution. By all these writers the solution is directed to be applied to the throat and opening of the larynx only. The practicability and safety of introducing the solution *within the larynx* does not seem to have occurred to them. M. Bouchut, indeed, enjoins the greatest caution in making the application over the glottis, lest suffocation should be induced by too great a quantity of the liquid passing into the larynx, or by allowing the sponge to remain too long upon the glottis.¹ The instrument used by the above writers for making the application, is a piece of bent whalebone, with a piece of fine sponge firmly attached to the end. M. Bretonneau directs the whalebone to be bent at five or six centimètres from its extremity at nearly a right angle.² Applied in this way at the commencement of the disease, there can be no doubt that many cases of

¹ Si la cautérisation de l'arrière-bouche et de la partie supérieure du larynx est avantageuse, elle a aussi ses inconvénients qu'il faut connaître pour tâcher de les éviter. La suffocation immédiate peut en être la conséquence, si l'on a laissé trop longtemps l'éponge sur la glotte, et si une trop grande quantité de liquide a pénétré dans le larynx. Cet accident est fort grave, car il peut déterminer la mort, ou au moins la nécessité de pratiquer aussitôt la trachéotomie. (*Manuel Pratique des Maladies des Nouveaux-Nés*, &c. Par M. Bouchut.)

² L'appareil est composé d'une éponge fine de la grosseur environ d'une noix, fixée au bout d'une baleine assez forte et recourbée, à la chaleur d'une bougie, à 5 ou 6 centimètres de son extrémité et presque à angle droit. L'éponge est imbibée d'une solution de nitrate d'argent (au degré de 4 grammes de ce sel pour 82 grammes d'eau distillée.) Elle est introduite dans le fond de la gorge; l'épiglotte est soulevée et la solution exprimée au-dessus de la glotte. (*Formulaire Thérapeutique*, &c., concernant les Maladies de L'Enfance.)

croup may be at once arrested without passing the sponge into the cavity of the larynx at all. Generally, however, in order to secure the full benefit of the application, the sponge must be made to enter the larynx. Numerous and repeated experiments have now abundantly shown that the dangers, considered by M. Bouchut as attendant upon the application of this remedy to the fauces and opening of the larynx (*l'arrière-bouche et la partie supérieure du larynx*), do not exist; and that the application may be made, not only to these parts, but that the sponge may be also carried into the cavity of the larynx, and through and below the vocal cords, not only with perfect safety in every case, but with the most prompt and decided therapeutic effect. Dr. Horace Green was, we think, the first who conceived the idea of introducing the nitrate of silver within the larynx in this disease; and to him justly belongs the credit of having discovered and practically demonstrated both the safety of the operation and its great therapeutic value. He has also established the interesting fact, that "much less mechanical irritation is produced by the application of the nitrate of silver into the larynges of young children who are suffering from croup, than when it is introduced into those of adults who are affected with chronic disease of the larynx." The strength of the solution generally used is two scruples of the nitrate of silver in crystals to one ounce of distilled water. A solution of this strength is found to produce less irritation of the mucous membrane, and to exert a more beneficial effect than a weaker one. The application may be made by means of a laryngeal syringe, or a sponge probang like that recommended by M. Bretonneau. The latter is generally to be preferred, since it also answers another important indication hereafter to be mentioned, which the syringe does not answer. The application should first be made to the fauces and pharynx only; and then, after ten or fifteen minutes, the head of the child being held by an assistant, and the base of the tongue depressed with a spoon or some other instrument, the sponge, saturated with the solution, is carried over the top of the epiglottis, and pressed quickly downwards and forwards into the larynx. The sponge should not be more than one-third, or at most one-half inch in diameter for a child two years old or over; under this age, it should be somewhat smaller. The effect of the application of this remedy, when made early in the disease, is not infrequently to arrest the inflammation at once; and hence the importance of its early application, since, as already shown, the tendency of the inflammation is always to extend downwards in the air-tubes. In every case of true croup, this application should be made *at our first visit*; and, if possible, over the whole extent of the inflamed membrane. The period at which the application should be repeated will vary in proportion to the severity of the disease and the effect produced. In the milder cases, once a day may be sufficient, while in those more severe it should be repeated three or more times daily. The operation is generally followed by cough, and a more or less free discharge of glairy and adhesive, or purulent matter, according to the stage of the disease; commingled frequently with shreds and patches of false membrane. Marked amelioration of the dyspnoea and cough almost uniformly follows. It is important that the operator be certain that the sponge really enters the larynx, for if he deceives himself upon this point the solution will be expressed into the oesophagus below the opening of the larynx, and of course no effect will be produced upon the disease. It is also desirable that the solution should, as near as possible, be made to reach the whole extent of the inflamed membrane.

"In most cases," says Dr. Horace Green, "it is only necessary to pass the sponge into the larynx; for the contraction of the glottis, which takes place

on the introduction of the instrument, presses the fluid from the sponge, which trickles down, and is diffused over the tracheal membrane." When, however, the inflammation extends to the bronchial tubes, it is desirable to pass the sponge through the rima glottidis, and into the trachea if possible. In relation to the feasibility of this operation, Dr. Green¹ asserted, more than two years ago, that he had "succeeded in passing an armed probang down to the bifurcation of the trachea, probably over five hundred times;" and that employing "a probang nearly straight, armed with a sponge," he had pushed the instrument, not only down to the division of the trachea, but, turning it aside, had "passed it at will, in many instances, into the right or left bronchus, with as much ease and safety as the catheter is introduced into the bladder."

II. *Remedies for moderating the Laryngismus.*—The remedies already advised for arresting the inflammation will generally also, at the same time, fulfil this indication. The action of an *emetic*, especially in the early stage of the disease, is generally followed for a time by a marked diminution of the laryngismus. After the disease is fully formed, however, the frequent repetition of emetics for this purpose is not advisable or judicious. When we have reason to believe it due chiefly to irritating matters in the stomach, a suitable emetic may be administered, if not otherwise contraindicated. *Ilydracynic acid* is a valuable remedy in fulfilling this indication, especially in the later stages of the disease. Decided relief of the dyspnoea, cough, and restlessness, may often be obtained by its administration. The *application of nitrate of silver* internally to the seat of the disease, as already advised under our first indication, is also an invaluable remedy for controlling the laryngismus in all stages and conditions of the disease. The *inhalation of watery vapour*, simple or medicated, with camphor, stramonium, or other narcotics, exerts also a favourable influence upon the laryngismus. Care should be taken, however, that they be not continued long enough, without intermission, to interfere with the already impeded aëration of the blood.

Tracheotomy.—The value and propriety of this operation in croup will be considered in another connection. It is conclusively shown, we think, by post-mortem appearances, that patients with croup do sometimes perish during a paroxysm of laryngismus from asphyxia thereby induced. In a case in which there seemed good reason to anticipate such a termination, notwithstanding the use of the remedies above advised, a resort to the operation would certainly be justifiable and proper.

III. *Means for preventing the Formation of a False Membrane.*—These may be included under two heads: 1. Remedies calculated to diminish the organizability of the exudation; 2. Means adapted to secure the removal of the exudation before the occurrence of organization. The remedies of most value under the first head are the preparations of mercury generally, of which calomel is much the most efficient. The value of this remedy in inflammations of serous membranes has long been an established fact in therapeutics. Its evident effect in these diseases is to promote absorption of the effusion, and to retard or prevent the formation of adhesions and false membranes. Absorption in these cases, is probably promoted rather by the direct effect of the mercurial upon the fibrin of the effusion than by any direct effect upon the absorbent vessels of the part. The direct effect of this class of remedies is probably to diminish the fibrin of the blood, and consequently that of the

¹ See Braithwaite's Retrospect, Part xxvi. p. 60.

inflammatory exudation also. It may well be doubted whether the preparations of mercury have any effect beyond this in controlling either the progress or consequences of inflammation. But it is certain that they do produce this effect upon the plasma of the blood—they diminish its *organizability*. They are, therefore, valuable remedies not only in all inflammations of serous membranes, but also in all inflammations in which false membranes are liable to occur. For the purpose, then, of diminishing the *organizability* of the exuded plasma, small doses of calomel ($\frac{1}{4}$ to 1 gr.) may be given every fourth hour or oftener; diminishing the quantity if any marked cathartic effect is produced, or adding, if necessary, to each dose a small quantity of the pulvis ipecac. comp. It should be borne in mind, however, that this remedy is capable of doing much harm in cases to which it is not adapted, even in the small doses above mentioned. "It is now pretty generally known that mercurial preparations (and especially calomel) are not well borne by scrofulous—and we will also add anæmic—subjects, whatever their ages or diseases. It produces great general debility; and if any accident exists requiring the aid of the reparative process, as an ulcer or a wound, it may indefinitely prevent this process from occurring, or even lead to phagedæna, or perhaps sloughing, in the part instead. The plasma always possessing a low grade of vitality (*organizability*) in such persons, becomes so far debilitated by the mercurial, that reparation is impossible; and it is only on discontinuing it, and substituting tonics and proper diet that the desired result ensues."¹ This condition of the blood-plasma in scrofulous and anæmic subjects, which prevents them from tolerating the action of calomel as just explained, diminishes also the probability of the organization of the exuded plasma in croup. If in any such case it is deemed necessary to give any mercurial, the pil. hydrargyri, or some other preparation, should be preferred to calomel.

The *subsulphate of mercury*, or turpeth mineral, is a valuable substitute for calomel in such cases. It may be given in about the same doses that we would give calomel in sthenic cases. The time at which the administration of the mercurial is commenced is a matter of some importance. To produce its good effects, it must be administered before the exudation has become organized; and this is often early in the disease. In sthenic cases, therefore, we consider it advisable to commence its administration at once; waiting only to evacuate the bowels in cases in which a cathartic is indicated.

Alkalies.—This class of remedies also diminishes the *organizability* of the plasma of the blood. Their effect in this way, however, is much less than that produced by mercurials. They may be given in asthenic cases in which mercurials are inadmissible; and in such cases they constitute a valuable substitute for preventing the formation of a false membrane. The carbonate or bicarbonate of soda, or a corresponding salt of potassa, may be given in doses of from three to five grains to a child one year old, and repeated every fourth hour. We generally prefer the bicarbonate of soda. In the later stages of the disease, when a stimulant effect is also desired, the *bicarbonate of ammonia* may be administered with advantage. By diminishing the fibrin of the exudation they also favour expectoration, and thus contribute to the second end to be secured under this indication, viz: to secure the removal of the exudation before organization has occurred.

The remedy which has perhaps been most relied upon for this purpose, is *emetics* frequently repeated. These have been given to an extent and with a recklessness almost incredible. A careful examination of the mechanism of

¹ Prof. Peaslee's Monograph on Croup, p. 23.

vomiting, we think, will show the complete impossibility of any matters contained in the air-tubes being ejected therefrom during the continuance of that act.¹ Carpenter says the act of vomiting "bears great resemblance to the act of coughing, differing chiefly in this, that in vomiting the *larynx is closed during the whole operation*, whilst it is only closed momentarily in coughing."² In both the first act is a full inspiration, by which the thorax is distended, the diaphragm becoming at the same time strongly contracted, and the rima glottidis closed; thus preventing the escape of the air from the air-passages. Next, in coughing, the rima glottidis is suddenly opened, and the abdominal muscles contracted forcibly, whilst the diaphragm at the same time relaxes; the lungs are thus suddenly compressed, and the contained air forcibly expelled from the air-passages. In vomiting, also, a full inspiration is first taken, the diaphragm contracted, and the rima glottidis closed, as before. Next, the abdominal muscles contract suddenly and forcibly, *but the rima glottidis remains closed, and the diaphragm strongly contracted*. The stomach is thus compressed between the contracted and depressed diaphragm and the abdominal muscles, and its contents expelled. But since the rima glottidis is closed, and the diaphragm contracted during the whole act, it is evident that nothing can be expelled from the air-passages. The use of emetics, therefore, for this purpose, is neither rational nor justifiable, since much injury is liable to result from them.

Expectorants.—The alkalies have already been mentioned as favouring expectoration by thinning the exuded plasma. After febrile action has subsided, the syrup of senega, or of squill, may be given for the purpose of increasing the expectoration, and thus aiding in detaching and removing the exudation.

Counter-irritants.—These are supposed to favour the absorption of the exuded plasma, and, in this way, they may have some effect in preventing its organization. After febrile action has somewhat subsided, stimulating liniments or blisters may be applied for this purpose.

The Sponge Probang.—The application of this instrument saturated with a solution of the nitrate of silver, as already advised for subduing the inflammation, is also by far the most efficient means for securing the removal of the exudation. More or less of this exudation is usually removed directly by the sponge, and the application is generally followed by cough and a considerable amount of expectoration. The solution, moreover, destroys the organizability of the exudation, and aids in the disorganization and detachment of the false membrane when formed.

IV. *Means for producing the Discharge of the False Membrane when formed.*—These are precisely the same as those specified under the last preceding indication for securing the removal of the exudation before organization has occurred; the most important of which is the *sponge probang*. The sponge should be carried into the trachea; and the operation repeated as often as the urgency of the case requires. The presence of the false membrane may not be as already stated, the only or the chief source of danger in this disease; nor its removal from the air-passage, however effected, always followed by recovery. When present, however, it must greatly increase the danger by impeding respiration, both directly by its bulk blocking up the air-passages,

¹ For an excellent argument on this point, see Prof. Penzlee's valuable and original Monograph on Croup, to which we acknowledge our indebtedness for many ideas and suggestions which we have seen nowhere else.

² Carpenter's Principles of Human Physiology, 3d American ed., p. 385.

and indirectly by increasing the laryngismus. Its speedy removal, therefore, is an object of the greatest importance. We would, therefore, urge the great importance, in all cases in which there is reason to suspect the existence of a false membrane, of a thorough application of this remedy for this purpose. A considerable number of cases are now on record in which the life of the patient has evidently been saved in this way. The sponge should be passed through the rima glottidis, and as low into the trachea as possible. This remedy, if it were not more efficient for this purpose than emetics, has certainly the great advantage over them of being entirely harmless in all stages and types of the disease. Emetics at this stage of the disease are generally entirely out of place, and ought *never* to be given for the purpose of removing the false membrane.

Tracheotomy.—The opinions of medical writers of the value of this operation in croup are various and contradictory; and, under existing circumstances, it is perhaps impossible to form a just estimate of its value. When resorted to, it has generally been only in the last and hopeless stage of the disease, when little benefit could be expected from any remedy. There is much truth in the observation of Louis, that “as long as bronchotomy is considered an extreme measure (*un dernier ressort*), it will be always performed too late.” It is evident that a correct estimate of the value of the operation can only be formed from a consideration of its results when seasonably performed. Considering the unpromising circumstances under which the operation has been generally resorted to, its results have been, on the whole, sufficiently favourable, in our view, to justify its continuance at least. We would, however, insist upon the importance—for the reputation of the operation as well as safety of the patient—of not delaying the operation in cases in which it is actually required, till all reasonable prospect of benefit is passed. The operation is said to have been much more successful in France than in England. This is accounted for partly, if not wholly, by the fact that the operation is performed earlier in the former than in the latter country. A judicious and persevering use of the local application of the nitrate of silver will no doubt diminish much the number of cases in which the operation would be otherwise required. In cases which have terminated fatally after the use of the sponge probang, it has been found that the false membrane was completely removed as low down as the sponge was passed.

It should be borne in mind that the object of the operation is not solely to allow more air to pass into the lungs than is admitted through the constricted rima glottidis. In cases in which a false membrane forms, the disease generally spreads rapidly to the trachea and also to the bronchi. In such cases, the benefit to be derived from tracheotomy is twofold:—

1. It enables us to aid in removing the false membrane, through the opening made in the trachea by mechanical means.

2. It enables us to apply topical remedies, such as the solution of nitrate of silver, through the same opening directly to the trachea and bronchial tubes. Trousseau, who has probably operated more times and with better success than any other surgeon, follows the operation with the application of the nitrate of silver in this way. And Prof. Peaslee thinks that circumstances may exist which would justify the operation for this purpose alone. Upon this point we may be pardoned for again quoting from his valuable *Monograph on Croup*. He says (p. 29): “But we may make an opening for the sake of making applications through it to the larynx, trachea, and bronchial tubes; and here an entirely new field opens to us. And we hope not to startle those overmuch who shudder at the idea, both of the operation and of the probang

now so frequently mentioned, if we say that, in our opinion, cases may occur in which it is justifiable to make an opening into the trachea for the mere purpose of applying the caustic solution and other remedies, directly to the seat of the disease, and to the extent required. If, for instance, the case be a sthenic one, while from spasm or swelling of the larynx, or some other cause, it is found impossible to pass the caustic solution through the rima glottidis, though it is very certain that a false membrane will be, or has formed, and all of several children of the same family attacked by the disease have died of it; in this combination of circumstances, certainly we should feel justified in performing the operation for the object now under consideration." In regard to the time at which the operation should be resorted to, no rule can be given. It should be performed, if at all, as soon as we become satisfied that other means will not prevent a fatal termination, and before the vital powers are exhausted through want of a due supply of aerated blood; whether it be at the end of twelve hours or a week. After the disease has extended to the smaller subdivisions of the bronchial tubes, and they have become to a considerable extent blocked up by the exudation, little benefit can of course be expected from the operation.

V. Means for supporting the Patient's Strength.—In the later stages of the disease, and throughout the course of the more asthenic cases, this is an important indication. It is to be borne in mind that the false membrane, when present, will be spontaneously detached and removed, provided the patient's strength holds out sufficiently long. We would, therefore, as far as possible, husband the patient's strength by the avoidance of all unnecessary medication, especially of powerful and prostrating emetics; and by the administration of suitable nourishment, adding, as the strength begins to fail, stimulants and tonics. Carbonate of ammonia, wine-whey, weak milk punch, or egg beat with wine may be used. Where a more permanent effect seems desirable, tonics may be also administered.

Summary of Treatment.—When called to a case of croup during the first paroxysm of laryngismus, it is generally proper to administer at once, if it has not been done before, a suitable emetic. We are in the habit of using for this purpose, more frequently than anything else, the *symplicium scillæ compositus*. To a child, two years old, this may be given in doses of half a teaspoonful, and repeated every fifteen or twenty minutes till vomiting is produced. In cases decidedly asthenic, we prefer a combination of ipecac and sulphate of zinc; and in sthenic cases, the tartrate of antimony, alone, or combined with ipecac, may be given instead of the above preparation, if preferred. The action of the emetic at this stage of the disease is generally followed by marked relief of all the urgent symptoms. The improvement, however, is rather apparent than real, and depends entirely upon a temporary relief of the laryngismus. Our remedies must now be directed vigorously to arresting the inflammation. Especially should it be borne in mind that the earlier, judicious, and vigorous treatment is instituted, the more prompt and beneficial will be its effects. Whilst the inflammation is confined chiefly to the larynx, we have it in our power, in addition to the general treatment, to apply local remedies to the whole of the diseased surface. This favourable period should, in no case, be allowed to pass unimproved. Experience has fully shown the danger and irrecoverable loss of delay. After the administration of the emetic, therefore, we would proceed at once to apply a solution of the nitrate of silver to the mucous membrane of the larynx with the

sponge probang. This should not be omitted in any case of actual croup. If the patient be robust and plethoric, the dyspnoea considerable, and the pulse very frequent, it is generally advisable to apply cups or leeches in the manner already advised; or, if the patient be over six years old, to take blood from the arm. In milder cases, however, this remedy may be safely omitted. In cases in which it is required, a cathartic dose of calomel may next be administered; and afterwards, except in cases decidedly asthenic, the patient should take small doses of the tartrate of antimony every hour, or every two hours, according to the urgency of the symptoms. The amount and frequency of the dose should be so regulated, if possible, as to produce a decided impression upon the character and frequency of the pulse, without causing vomiting. At this stage of the disease, this is altogether the most important internal remedy we possess. At the same time, also, we generally order small doses of calomel every four hours. In the severer cases, cold water may, at the same time, be applied to the throat in the manner already advised.

In asthenic cases, in which the tartrate of antimony is not admissible, the nitrate of potash may be freely given in solution instead; and if any mercurial is considered necessary, the turpeth mineral, or pil. hydrargyri, should be substituted for the calomel. In such cases, local applications of the nitrate of silver must constitute our main dependence. They should, therefore, be made with the utmost thoroughness, if possible, over the whole extent of the inflamed membrane, and repeated as often as the symptoms indicate. If repeated every two hours, it will do no harm. In many cases these remedies will arrest the disease at once. It is not, indeed, unusual to see cases of considerable severity arrested within twenty-four hours by the sponge probang and tartrate of antimony alone. Should the disease, however, continue, notwithstanding the use of the above means, the application of the nitrate of silver should be repeated, and the tartrate of antimony continued in doses proportionate to the frequency and hardness of the pulse and the heat of the skin. Should the antimony cause diarrhoea or otherwise disagree with the patient, the lobelia may be substituted. If the laryngismus is severe, the patient may also be allowed to breathe the vapour of hot water, simple or medicated, with camphor or stramonium, or some other narcotic; but for a few minutes only at a time. The mercurial, in cases to which it is adapted, may also be continued; or in asthenic cases, the bicarbonate of soda, or some other alkali, may be administered with a view to diminish the organizability of the exudation. Should there be evidence in the progress of the disease of the formation of a false membrane in the larynx and trachea, the sponge-probang should be more frequently and perseveringly used. When the heat of the skin has subsided, some stimulating liniment may be applied to the throat, and the cold water, if previously applied, omitted. At this time, also, the senega or squill may be administered with benefit. Should the disease, however, progress, notwithstanding the above treatment, including the frequently repeated and thorough application of the nitrate of silver to the seat of the disease, and the lips become livid or purple, the dyspnoea great, and signs of exhaustion begin to appear, the tartrate of antimony and nitrate of potash should be at once omitted and stimulants cautiously substituted. At the same time, the operation of tracheotomy may be considered. The indications for this operation, and the objects to be secured by it, have already been sufficiently discussed, and need not be here repeated.

REVIEWS.

ART. XII.—*A Manual of Pathological Anatomy.* By CARL ROKITANSKY, M. D., Curator of the Imperial Pathological Museum and Professor at the University of Vienna, etc. Translated from the last German edition, by WILLIAM EDWARD SWAINE, M. D., CHARLES HEWITT MOORE, EDWARD SIEVEKING, M. D., and GEO. E. DAY, M. D., F. R. S. Four volumes in two. Philadelphia: Blanchard & Lea, 1855.

WHEREVER Rokitansky's name is known, he is understood to be the first living authority on morbid anatomy. Making that branch his exclusive study, and placed for many years in a position which gives him unexampled opportunities for its practical pursuit, he has accumulated an amount of information that places him far in advance of any other writer of the present time. The great General Hospital of Vienna, comprising in a single organization all the charitable medical institutions which in other cities are scattered and separate, is more like a vast citadel of hospitals than an ordinary establishment. It supplies in constant abundance all the usual forms of disease, besides presenting from year to year a certain proportion of the rarer varieties. All the patients dying here are, by law, subject to a *post-mortem* examination, provided their cases present a sufficient degree of interest to make it desirable. Their bodies are, as a matter of course, brought to the dead-house, for Rokitansky and his assistants to make their selection of those they may desire to examine. Besides this, in all cases requiring judicial investigation, the autopsies are conducted by Rokitansky. The bodies of all persons found dead, of those who are killed accidentally or by violence, or who die suddenly from any unusual cause in the city or its suburbs, are brought to the hospital dead-house and subjected to his examination. In the dead-house there are three rooms, one of which is devoted to the reception of the bodies, while the other two are autopsy-rooms. Every morning there are, for some hours, two autopsies going on at a time; and the visitor will sometimes see on each table two subjects, laid end for end, the dissections being carried on simultaneously by the assistants, while the chief supervises their work and dictates the record. The immense superiority of these advantages is so fully appreciated by the Austrians, that they are not disposed to allow the possibility of morbid anatomy being thoroughly studied anywhere else, and will sometimes scout, in a rather presumptuous manner, the pretensions of any foreign observer to maintain a pathological doctrine at variance with those taught in the Vienna school. With Rokitansky himself, however, there is no superciliousness of this sort; and his authority is all the more readily, and, we believe, universally, acknowledged.

A striking peculiarity of the book under consideration is the absence of quotations corroborative of the author's statements. Rokitansky's *Pathological Anatomy* is Rokitansky's own work. It is the record of appearances observed in the dead-house at Vienna, and does not depend for any considerable part of its interest or value on materials drawn from other sources. This peculiarity becomes very evident when a comparison is made with other works

on similar subjects, of which so large a part is frequently made up of compilation and the repetition of statements previously made elsewhere. This sort of scientific independence is becoming every day a more essential requisite for authorship. Mere erudition in medical matters, a familiarity with what has been done and said by others, is no longer regarded with the same respect as formerly. It is still very properly considered as a requisite ingredient in a man's scientific education, but does not of itself give him any special claim to distinction. Still less does it enable him to take any prominent place as an author: and the man who now writes a book devoted exclusively, or in great part, to what is called the "literature" of his subject, is rather looked upon as having gained the attention of the public under false pretences, than as having added anything very valuable to the common stock.

By these remarks it is not intended to deny altogether the value of scientific compilation, if kept in its proper place and done in a proper manner. A systematic book, entirely made up of such compilation, it is true, hardly merits an existence; but, on the other hand, one which dispenses with all notice of previous writings is on that account certainly incomplete. If there be any deficiency in Rokitsansky's book, it lies in this direction, since the reference which he makes in the Introduction to older writers is hardly more than an enumeration of their names, without anything like a complete or connected review of their works. It is a matter of some real importance, no less than of literary interest, after becoming acquainted with the actual state of our knowledge on any subject, to learn the previous phases through which our knowledge has passed before arriving at its present condition. As Robin expresses it, in his *Chimie Anatomique et Physiologique*, "no investigation is complete until we know the route which science has followed in the series of ages, and the successive efforts by which it has attained to its present position." No one, indeed, has better comprehended than Robin the true place and object of scientific compilation, as an entirely subordinate, but, at the same time, important, part of a systematic treatise. He observes in this connection, while speaking of the *proximate principles* of the animal body:—

"We must remember that the study of the proximate principles, like that of everything else, has its roots running into the past. We must search for them, therefore, wherever they are to be found, and disentangle them from other facts of a different nature, by which they are surrounded and concealed. This is to be done, not merely from motives of curiosity, but in order to learn the successive attempts by which our knowledge has been accumulated; so that we may in some instances follow the example of our predecessors, and in others avoid wasting our time by the repetition of fruitless experiments." * * * "It is important to remark that in every science, and particularly in the science of life, we must avoid confounding that which actually is with that which has been said—what is to be found in organized bodies with what is to be found in books—or science itself with the history of science. The history of science is, again, itself entirely distinct from *erudition*, which latter is acquainted only with scientific names and historical facts, without pretending to understand their affiliation."

The present translation must be regarded as quite successful, if we take into consideration the difficulties of the author's style, which is at times exceedingly involved, and never an easy one. While describing, for example, the "typhous process" in the mucous membrane of the small intestine, he says (vol. ii. p. 63):—

"In the second stage the congestion is diminished; the injection and reddening, and even the swelling of the mucous membrane, retract within circumscribed spaces which correspond with Peyer's agminated glands, or occasionally

with solitary follicles. Rounded, or more commonly elliptical, tumefactions (plaques), varying in thickness from half a line to three lines, are formed, which result from the deposition of a peculiar substance in the tissue of the Peyerian plexus, and of the submucous cellular tissue. They are surrounded by a vascular wreath which stops short at their circumference, and by a marginal plane which rises abruptly, or is contracted, so as to appear pediculated. In the latter case they the more resemble flat sessile fungi, as they often present an umbilical indentation at their centre. According to the amount of matter accumulated, the mucous membrane is more or less tense, being intimately blended with the deposit, as this again is firmly and immovably attached to the muscular coat of the intestines."

Again, in speaking of deviations in size of the spleen (vol. ii. p. 131):—

"Deviations in size consist either in an abnormal increase or diminution of the organ. The former is of particular importance, and those tumours afford a special interest which depend upon congestion caused not by mechanical impediments, but by the peculiar relation of a morbid state of the blood to the spleen. With the rare exceptions of those cases in which, like analogous states of the liver, they are congenital, these conditions are acquired. They are either acute or chronic: in the former case they accompany other acute diseases, either during their entire course, or only during single stages; in the latter the tumefaction results from dyscrasie or cachectic conditions, which induce congestion, induration, and hypertrophy of the spleen. These terms, however, from referring mainly to external appearances, are apt to cause the real nature of the disease to be overlooked."

The meaning of the author is even sometimes rendered a little obscure, as in the following instance, where there seems to be a singular confusion of terms:—

"Cancerous morbid growths (of the mouth and fauces) do not *often* occur, if we except *two cases* in which a malignant tumour has made its way into the mouth and fauces from without. Cancerous degeneration of the tonsils is peculiarly rare," &c. "Still, cancer of the lips, and especially of the nether lip and of the tongue, where it chiefly attacks the posterior half, is not unfrequent." (Vol. ii. p. 20.)

Notwithstanding these peculiarities of style, however, the author's delineation of morbid appearances is occasionally remarkably graphic and complete. There is no more striking instance of this than his description of the third stage of typhous ulceration in the small intestine (vol. ii. p. 64):—

"The most remarkable change is now effected in the typhous patches and in the mesenteric glands; they soften. The patches become more tumefied, and, if the softening process does not affect them uniformly, they acquire an uneven, tuberculated surface. The deposit is converted into a grayish-red medullary mass; this may, from the imbibition of bile, be at once metamorphosed into a dirty yellow or brown slough, involving the investing mucous membrane. The slough shrivels up in a vertical and lateral direction, becoming loose at the edges and pulsatious, splitting in various directions, and detaching itself from the lowest stratum of submucous cellular tissue, by which means it is wholly or in part discharged; or the morbid product degenerates, when the epidemy is of a very intense character, into a loose, vascular, fungous growth, which is traversed by streaks of extravasated blood, or is entirely saturated with blood; it is the chief source of profuse intestinal hemorrhages, and is generally discharged piecemeal, without antecedent sloughing."

The arrangement adopted in treating of the different affections to which any organ is liable is exceedingly simple and complete. After a very few preliminary remarks, the author usually speaks first of arrest and excess of development; secondly, deviations of size; thirdly, deviations of form; fourthly,

deviations of position; fifthly, deviations of consistency; sixthly, solutions of continuity; and seventhly, diseases of the tissue: taking up, in this way, the most difficult and important division of the subject last. In the section, for example, devoted to the morbid appearances of the *spleen*, he enumerates first those varieties of congenital malformation in which it is absent, and mentions that it is found double in biventral monstrosities. He refers to the occasional existence of small supplementary spleens, a variety of formation which is to be regarded, according to Rokitsansky, not as an increase, but simply as a subdivision, of the main organ. There are said to be present occasionally as many as twenty of these in a single case. The deviations in size of the organ consist of acute or chronic tumefaction on the one hand, and on the other of atrophy, resulting either from occasional causes, as cholera, the internal use of steel, &c., or occurring naturally with the progress of age (senile involution of the spleen). The deviations in form are enumerated as presenting a tongue-shaped, platter-shaped, nearly cylindrical or angular mass; or an organ with its edges more or less deeply indented, so as to approximate, or even run into, the condition of transverse division. The deviations of position are those in which the organ protrudes from a fissure in the abdominal walls, is contained in an umbilical hernia, is displaced into the left thoracic cavity (diaphragmatic hernia), or is dragged down or pushed up by enlargements of other organs surrounding it. Under the head of *solutions of continuity* is mentioned the extremely singular and interesting fact that the spleen may be ruptured, not only accidentally, from external violence, but also spontaneously, in consequence of acute tumefaction. The author vouches for the occurrence of this spontaneous rupture of the spleen in typhus, in "typhoid cholera" (meaning probably the secondary fever, or stage of reaction), and in the hot stage of intermittent fever; and mentions that death may result from the consequent hemorrhage. Of diseases of texture occurring in the spleen, the writer considers the two most important, hyperæmia and inflammation, as at present but imperfectly understood, and as requiring for their elucidation a clearer notion than we now possess of the structure of the organ, and more especially an advance in our knowledge of the pathology of the blood.

"These diseases of the spleen," he says, "are probably but rarely idiopathic; they almost always arise from certain anomalies of the blood and serum, or from certain dyscrasias (alterations in the constitution of the blood) which, although little known and as little understood, bear a remarkable and positive relation to the spleen. The spleen may, in fact, be considered as the most sensitive test for a variety of dyscrasic states of the fluids."

In speaking of hyperæmia of the spleen, it is to be regretted that some notice was not taken of the physiological variations in size of the organ connected with the digestive process. These periodical tumefactions, though not at all indicative of any morbid affection, might very readily mislead any one not acquainted with their existence, into mistaking a normal for a pathological appearance.

Another very frequent and striking *post-mortem* appearance, which we could wish the author had treated of a little more clearly, is *softening of the stomach* in consequence of disease, as distinguished from that which is simply the result of a digestive action of the gastric fluids taking place after death. Rokitsansky admits three forms of *ante-mortem* softening of the coats of the stomach. The first is a "gelatinous" softening, in which the softened tissues are pale and transparent, with a few dark-coloured vessels running through their substance. This form, a disease peculiar to infancy, is thought to be connected with some subacute affection of the brain, most frequently hyper-

trophy or hydrocephalus, of sufficiently long standing to have induced general anæmia. It is this general anæmic condition that accounts for the pallor of the altered parts. The other two forms differ from the first in this particular, that the softened pulp is dark-brown or blackish in colour, owing to the presence of a considerable quantity of blood, which is blackened by the action of the gastric fluids. One of them depends, like the first, on a cerebral affection, which has, however, run a rapid instead of a slow course, and which has consequently brought on the softening without inducing any previous anæmia; and the other is thought to be "a sequela of certain cachexie, which were either originally acute or have become so under the influence of certain circumstances, viz: the exanthematic, the croupy, the typhoid, in the widest senses, pyæmia, acute tuberculosis, acute cancer—it is then to be viewed as a fatal degeneration of those diseases."

It is well known to every one at all versed in *post-mortem* examinations, that softening of the stomach at its cardiac extremity, and often also of the adjacent organs, is very frequently the consequence of a *post-mortem* action of the gastric juice upon the dead tissues. Rokitansky himself, in speaking of the above forms of diseased softening, says that they "are to be carefully distinguished from cadaveric softening, the self-digestion of the stomach." It is not, however, easy to see what induces him to regard them as ever dependent on any other cause. In every instance, the softening is confined to the fundus of the stomach, or originates there and spreads thence to the neighbouring parts. It is distinctly stated that "in none of its stages" does it present, at any point, any of the signs of inflammation. It is "never circumscribed, but is shaded off gradually into the surrounding tissues." It occasionally proceeds to such an extent that the softened portion easily tears between the fingers, and these rents occur, it is said, "perhaps in rare cases during life, but probably oftener after death," giving rise to effusion of the gastric contents into the abdominal cavity. Rokitansky does not speak, however, of ever having observed any signs of peritonitis accompanying such an effusion, and indicating that it had taken place before death. On the contrary, when the gastric fluids are thus effused into the peritoneum or left pleura, the effusion "gives rise to a similar process (softening) in the serous membrane, accompanied by the evolution of gas." The fat of the softened tissues, also, is liberated from the fat vesicles, just as in ordinary digestion, and floats in the fluid mass in the form of oil globules. When the softening extends to the lower part of the œsophagus, a perforation sometimes takes place through the left side of the tube, and the gastric contents are discharged into the left pleura. The presence of a turbid fluid in the left pleural cavity with oil-drops floating in it, is, in fact, a pathognomonic sign of this sort of perforation, and from it alone the perforation of the stomach or œsophagus has been occasionally predicted in the Vienna dead-house, a prediction always verified on extending the examination to the abdomen.

Rokitansky himself admits, not only that softening may take place after death from the operation of cadaveric chemical changes, but also that it is not always easy to decide between this self-digestion of the stomach and morbid softening. "Nay," he says, "it is a matter of impossibility for the conscientious pathologist, unless he takes the previous disease and mode of death into consideration." The circumstances which may serve to distinguish ordinary cadaveric softening are, according to Rokitansky:—

1. The absence during life of all symptoms which indicated softening or the processes which give rise to it.
2. Sudden death from natural or other causes, during the digestive act, while the stomach is filled with chyme, without previous illness.

3. Limitation of the softening to the mucous membrane (?) and especially to the projecting folds, so as to form streaks.

4. And at the same time its extension beyond the bounds of morbid softening—its development being most remarkable at those parts at which there is a stagnation of the greatest quantity of the gastric contents.

We confess that we are unable to comprehend fully the reasons for connecting the softening of the stomach in any case with a cerebral disease, or with an "exanthematous, croupy, or typhoid cachexia" rather than with the digestive action of the gastric fluids, which always, when present, gravitate after death into the fundus of the organ, and accumulate there in greater or smaller quantity.

One of the most interesting portions of the work is the chapter on "Blood Diseases," or "Dyscrasie." Rokitsansky gives a large place, in his scientific creed, to the active influence of the fluids; considering them at least as important in respect to morbid processes as the solids. "Humoral pathology," to use his own words, "is simply a requirement of common practical sense." Not that he is at all exclusive in his opinions on this point. He recognizes everywhere the existence of local, as well as of general diseases; but he regards the purely local morbid alterations as comparatively rare, while many of those which are often considered as such, he regards as the local expression only of a general disturbance of the system, and most often of an anatomical change in the constitution of the blood.

"We believe," he says (vol. i, p. 276), "that ordinary pneumonia, with fibrinous product, is, for the most part, the localization of a pre-existent, that is, a precursorily developed crasis, characterized by an incontestable relation to the lungs, and to the mucous membrane of the air-passages."

Different varieties of inflammation thus owe their distinguishing characters to different modifications in the organization of the blood. He is led to this view, too, purely from his observations in morbid anatomy. Seeing so often, in his *post-mortem* examinations, the solids too little altered to account in any satisfactory manner for death, seeing various organs in different and distant parts of the body, presenting simultaneous and similar alterations, and observing, too, not infrequently unnatural appearances in the consistency, colour, and coagulability of the blood, accompanying the above phenomena, he is compelled to regard the blood itself in many instances as the part primarily diseased.

"Not alone," he says (vol. i, p. 371), "has pathological anatomy demonstrated the existence of blood diseases in unlooked-for detail; it has at the same time solved a problem of the weightiest import. It has, we think, *decided in favour of a humoral pathology*, by demonstrating a primitive anomaly of blastemata; by demonstrating the endogenous impairment of the blood within the vascular system, in the inflammatory process, as the basis of the variation in exudates (blastemata); lastly by demonstrating the dependence of local morbid action upon the pre-existent impairment of the general circulation. Our attention will be here directed to diseases of the blood in its totality; and to local dyscrasial processes, with inflammation at their head, only in so far as these offer the basis and starting point for consecutive disease of the entire blood-mass. It is remarkable, however, and no less important for practice than for science, that the essential forms of these local dyscrasial processes—perhaps of all local dyscrasial disease—occur likewise as primitive affections of the entire blood mass. This is proved by the varied character of the products of the inflammatory dyscrasial process, and a comparison in detail of these products with anomalies of the general blood crasis. Thus primitive pyæmia, fibrin crasis, sepsis of the blood, severally occur independently of all local beginning, and of all infection, * * * * It is the business of pathological anatomy to

determine both the physical properties of the blood in its totality, and also the relative quantity, and more especially the quality, of its more immediate components. The two main components which come peculiarly within its province are, first, those essential form-elements, the *blood-globules*; and secondly, the spontaneously separating, coagulating, solidifying *fibrin*, that component which, owing to its varying tendency to become organized, is, in an anatomical sense, the most important of all."

From this starting point, Rokitansky develops his remarkable theory of the *crases*. By the term "*crasis*" he means that special constitution or organization of the blood, produced by the admixture, in particular proportions, of the various ingredients (albumen, fibrin, fat, salts, &c.) of a particular quality. The *crasis* may, therefore, be a normal or an abnormal one. In the latter instance it is often spoken of as a "*dyserasis*" or "*dyserasia*." With regard to the mode of production of these abnormal states of the blood, they may be primary or secondary.

"To diseases of the solids, as local morbid processes in the broadest sense, affections of the blood stand in a twofold relation.

1. *The anomalous crasis is a pre-existent one—the primitive affection; the local disease a localization thereof—the secondary affection.* The point of localization, apart from the effect of concurrent external influences, is determined by a specific relation of the *crasis* to certain organs presided over by the nerves. The forms it assumes are chiefly those of hyperæmia and stasis—inflammation, absolute stasis—exudation, or without the latter a product formation completed within the bloodvessels; for instance, spontaneous coagulation of diseased fibrin, pus-formation within a greater bloodvessel, or within the capillaries of the organ. The relation of the various *crases* to the organs and textures, nay, even to particular sections of organs, is manifold. Thus the croupous fibrin-*crases* evince a very marked preference for the mucous membrane of the air-passages, and for the lungs themselves; the typhous *crasis* for the mucous membrane of the ileum; the exanthematous *crasis* for the common integument and for mucous membranes.

2. *The anomaly of the general crasis is consecutive; that is, the consequence of a local disease, and especially of local dyserasial processes, whereof the products are taken up into and affect the entire blood-mass.* This happens

First, through resorption of the effused products by means of the lymphatics, or immediately into the veins.

Secondly, through reception into patent bloodvessels. This process includes the reception of products thrown out into the cavity of larger bloodvessels; pus, for example.

Thirdly, most of all through the off-flowing, and the return into the veins, of plasma degraded in the local process, in a manner corresponding with the quality of the exudate."

The different *crases* are designated according to the ingredient principally affected, or the character of the local process to which it gives rise. There is, in the first place, the *fibrin crasis*; in this, the fibrin of the blood is altered in quantity or quality, or both. A fibrin *crasis* is not necessarily characterized by an increase of coagulable matter in the blood (hyperinosis), but sometimes even by a diminution of it (hypinosis). Or the fibrin may be simply altered in character, so as not to present its usual physical appearances, or the ordinary phenomena of coagulation. The principal forms of this variety are three: the simple fibrin *crasis*, in which the effused fibrin becomes organized into false membranes, the "*croupous*" *crasis*, in which the fibrinous exudation has a tendency to liquefy rapidly, and become disintegrated, and the "*tubercle crasis*," in which the tuberculous deposit, according to Rokitansky, is of fibrinous origin, but degenerated in character. Then come *pyæmia*, or the purulent *crasis*, which is not only dependent on a purulent absorption and infection, but occurs also as a "*primitive and spontaneous*" affection of the

blood—*plethora*, *nervous hypnosis*, the *typhous* and *exanthematous* crases, the *drunkard's* dyscrasis, the *crasis of acute tuberculosis*, which is regarded as different from that of ordinary or chronic tuberculization—the *cancerous* dyscrasis, *anæmia* and the *putrid* or *septic* crasis.

The last variety is regarded as consisting in the death, more or less complete (necrosis), and decomposition of the blood. It may present itself under the principal forms: 1st. A decomposition and necrosis of the blood, produced by a faulty diet (*scurvy*), the reception of corrupt matter, miasmata, animal poisons, &c., into the circulation, or by sudden and violent shocks to the nervous system, as concussion from falls, extensive crushing and laceration of the bones and soft parts, extensive amputations, overpowering electrical shocks, exhausting convulsions, difficult and prolonged parturition, or severe mental emotion. "In all these cases the blood is found attenuate, in colour comparable to a raspberry jelly, or of a dingy red, facile of imbibition, expanded in volume, often engaged in gas-development, frothy. Coagula, if present at all, appear as very inconsiderable, soft, curd-like fibrin clots. The corpses pass into putridity, under the phenomena of gas-development in the blood-vessels, emphysema in the textures, copious transudation of a dirty red serum into the serous cavities, and spontaneous vesication of the epidermis." 2d. There is also a decomposition of the blood which results from a "degeneration of the typhous, exanthematous, cholera, or drunkard's dyscrasis. Very often, however, these two forms do not differ in the appearances presented by the blood itself, and are to be distinguished only by reference to the accompanying or preceding alterations in other parts.

The above theory of blood diseases will not, perhaps, be adopted in all its particulars, by other pathologists. Rokitsansky has himself, we understand, modified his views, of late years, in regard to various details of classification. We must expect, indeed, still further modifications to become necessary in any classification that might now be adopted, since there remains so much to be learned of even the physiological constitution of the blood, and its variation in different parts of the body. Still, it is an effort made in the right direction. The morbid anatomy of the solids has already carried us nearly as far as it is capable of doing; and the next addition of any great value to our present knowledge on the subject will undoubtedly be derived from a patient and well-directed anatomical examination of the fluids.

J. C. D.

ART. XIII.—*Letters to a Young Physician just entering upon Practice.* By JAMES JACKSON, M. D., LL. D. Boston, 1855: 12mo., pp. 344.

AMONG the physicians of Boston who stand first in age, as well as in character, learning, and reputation, one after another has given to the world a volume containing his gathered essays, or the results of his mature experience. These comparatively scanty productions seem to show that whatever else our eastern brethren may have performed, writing has not been their customary occupation. With natural powers, high cultivation, and a social unity rarely to be met with elsewhere than in their own city, we had a right to look for some higher proof of their knowledge and skill than a reputation which may fade from the memory of man before the tomb has hardly closed upon their ashes. That they have given us some pledge of their power, some token of their ability to sustain with honour the scrutiny of less partial judges than their own townsmen, only makes us regret the more that we should, so late